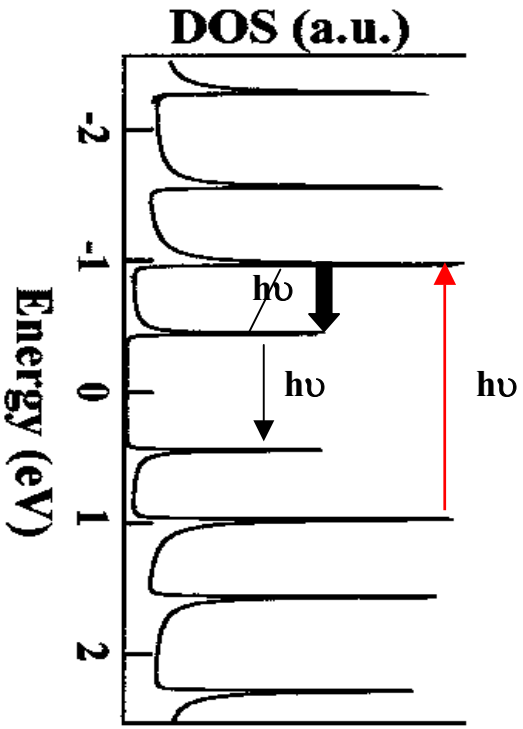
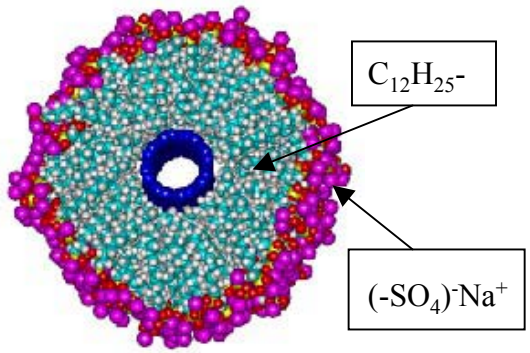
Band Gap Fluorescence from Semiconductor Single Wall Carbon Nanotubes

R. B. Weisman, G. Scuseria, R.H. Hauge and R.E. Smalley, Rice Univ. Houston, Tx

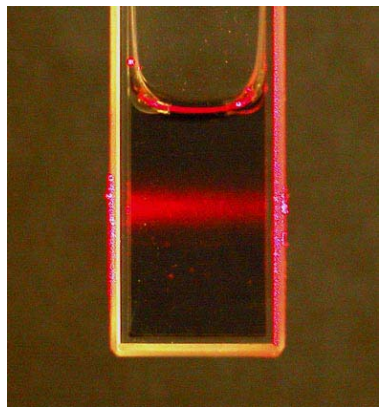
van Hove Singularities in Electronic DOS for SWNT



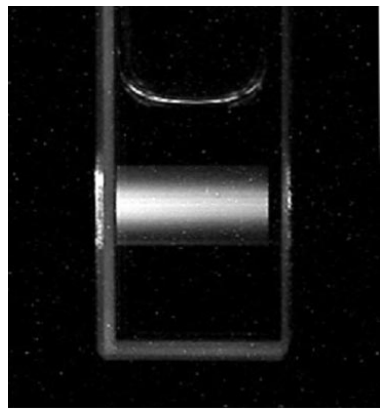
Single-Wall Carbon Nanotube (1nm diam.) in Cylindrical SDS Micelle



Individual SWNT in 1% SDS Surfactant-Water mixture



Excitation (661 nm)



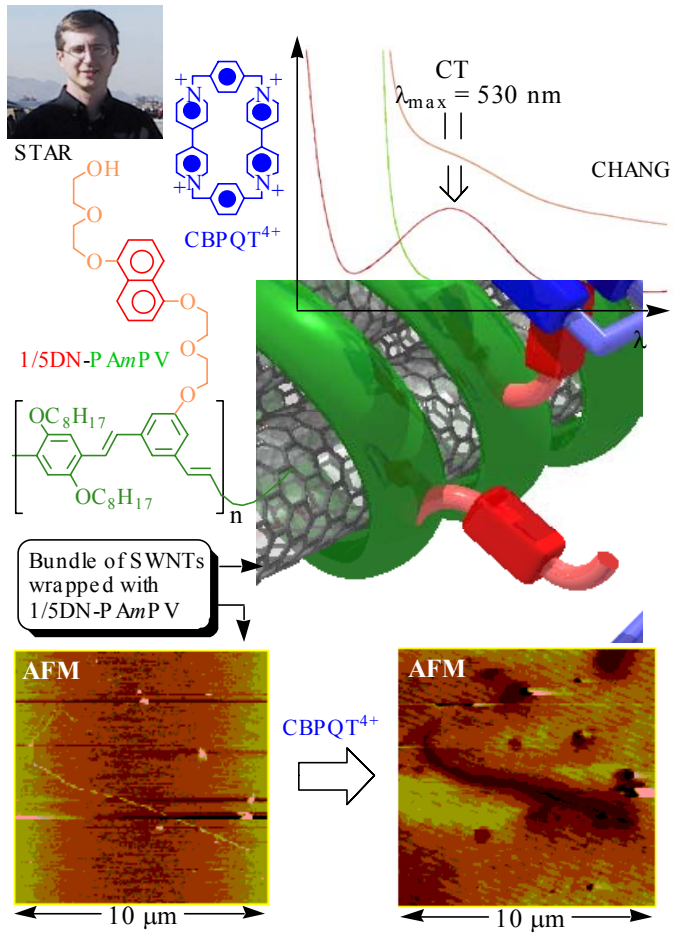
Emission (> 850 nm)

NSF#0073046

Noncovalent Sidewall Functionalization of Single-Walled Carbon Nanotubes

J Fraser Stoddart & James R Heath, CNSI, UCLA

The viewgraph describes some recent developments in chemical functionalization of single-walled carbon nanotubes (SWNTs). 1,5-Dihydroxyethoxynaphthalene-containing poly{(5-alkoxy-*m*-phenylenevinylene)-*co*-[(2,5-dioctoxy-*p*-phenylene)vinylene]} (1/5DN-PA*m*PV) polymer forms polypseudorotaxanes with π-electron-deficient cyclobis(paraquat-*p*-phenylene) ($CBPQT^{4+}$). Wrapping these functionalized polymers around SWNTs results, in essence, in the grafting of pseudorotaxanes along the walls of SWNTs in a periodic fashion. Atomic Force Microscopy (AFM) images of SWNT bundles wrapped with the 1/5DN-PA*m*PV polymer show obvious change in the surface potential mode upon addition of $CBPQT^{4+}$ molecules. It is clear that noncovalent functionalization of carbon nanotubes can be achieved without disrupting the primary structure of the nanotubes themselves. In this regard, noncovalent functionalization has potentially a virtue that all forms of covalent functionalization lack.



NSF#0073046

N
S

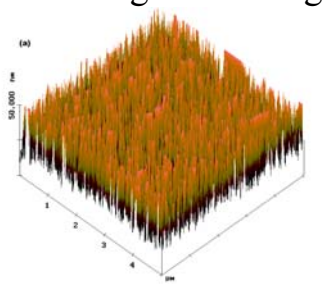
Ozonation of Single-Walled Carbon Nanotubes and Their Assemblies on Rigid Self-Assembled Monolayers

Lintao Cai, Jeffrey L. Bahr, Yuxing Yao and James M. Tour , Rice Univ. Houston,Tx

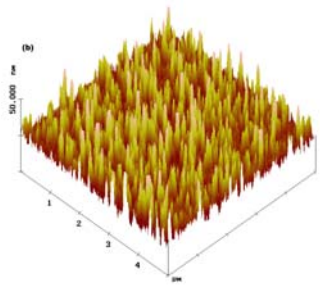
• Ozonation of single-walled carbon nanotubes (**O_3-SWNT**s) produces oxygenated functional groups, e.g., carboxylic acid, ester and quinone moieties.

• **O_3-SWNT** is assembled on functionalized self-assembled monolayers (SAMs) of conjugated oligo(phenylene ethynylene)s via layer-by-layer (LBL) deposition with bridging of metal cations.

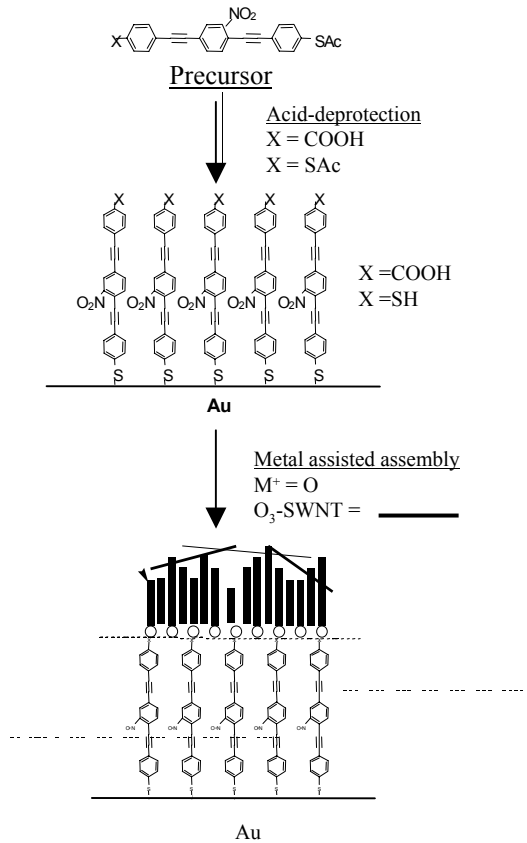
• The oxidatively shortened **O_3-SWNT** is shown to be perpendicular to the surface with random adsorption of longer tubes as seen in the following AFM images.



O_3-SWNT/Fe^{3+}/SAM-2 (precursor X = -CO_2H)



O_3-SWNT/Cu^{2+}/SAM-3 (precursor X = -Sac)



•The patterned nanotube assemblies may be useful in hybridized electronic devices, where device functions can be modified by the orientation and stacking of SWNTs, and the properties of the SAM.

NSF#0073046

Research, Education and Outreach Accomplishments 2001-2002
Fullerene Nanotube Chemistry

PI-R.E. Smalley PI, Rice Univ.
Co-PI-J.M. Tour(Rice), F. Wudl, J.R. Heath, and J.F. Stoddart (UCLA)

Research:

•Band gap fluoresence was observed for the first time from individual semiconductor SWNT in the near IR (0.8-1.6nm). This spectral region is important in fiberoptic communication and bioimaging.

- Procedures developed that produce water suspensions of individual SWNT in surfactant micelles
- Noncovalent solubilization of small bundles of SWNT achieved with supramolecular wrapping. Optical excitation of the supramolecule shown to strongly enhance electron transport through the SWNT bundle.
- Covalent oxidation of SWNT with O_3 leads to end on attachment of SWNT to functionalized self assembled monolayer

Education:

- Support provided for the following: 8 postdoctoral, 13 graduate, 4 undergraduate students, 1 high school student and
- 2 research staff and 6 faculty.

Outreach:

- High school student worked in the Rice research laboratory during the summer and developed a project on SWNT for a Texas-wide science fair. He captured first prize state-wide and second prize nation-wide.

NSF#0073046